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**Informational
Letter**

IL 85-2

To: All Oil, Gas, and
Pipeline Operators

15 March 1985

LEAK PREVENTION AND DETECTION

This informational letter supercedes Informational Letter IL-PL 76-1.

Attached is the latest edition of the Canadian Petroleum Association Recommended Practice for Liquid Petroleum Pipeline Leak Prevention and Detection in the Province of Alberta (CPA Recommended Practice).

Since 1976, the Board has used the CPA Recommended Practice as a guide for determining the minimum requirements for leak prevention and detection methods and procedures for liquid petroleum pipelines in Alberta. The Board encourages pipeline operators to utilize the new edition to review and determine the appropriate level of the leak prevention and detection practices for their respective existing pipeline systems with the objective of compliance, particularly for urban or environmentally sensitive areas.

All new pipeline systems will be required to meet the requirements of this new edition of the CPA Recommended Practice. Accordingly, the Board will seek an Order in Council to amend the Pipeline Regulations to reference the latest edition of the CPA Recommended Practice.

Inquiries should be directed to the Board's Pipeline Department, telephone 297-8320, telex 03-821717.

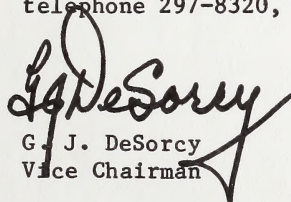

G. J. DeSorcy
Vice Chairman

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RECOMMENDED PRACTICE

FOR

LIQUID PETROLEUM PIPELINE

LEAK PREVENTION AND DETECTION

IN THE PROVINCE OF ALBERTA



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* Some definitions and interpretation with respect to this Recommended Practice are limited solely to defining population density areas in a way which is consistent with industry standards. They are not to be construed as an application or recommendation to apply CSA Z182 Standards to LTP pipelines.

1. SCOPE

1.1 This Recommended Practice applies to intra-provincial pipelines within the Province of Alberta and is intended to serve as a method by which pipeline operators can achieve uniform standards for establishing leak prevention and detection procedures on liquid petroleum pipeline systems. Although the standards of operation contained herein should generally apply, the individual operator should develop procedures to cover the unique characteristics of each pipeline.

1.2 Objective: The objective of this Recommended Practice is to minimize the occurrence of liquid petroleum leaks and to facilitate their early detection.

1.3 Application

1.3.1 This Recommended Practice applies to liquid petroleum pipeline transportation systems covered by CSA Standard Z183 (latest edition) with the exception of multi-phase pipelines.

2. DEFINITIONS

2.1 Low Vapour Pressure (LVP): Hydrocarbon mixtures with a vapour pressure less than or equal to 240 kPa at 38°C.

2.2 High Vapour Pressure (HVP): Hydrocarbon mixtures with a vapour pressure exceeding 240 kPa at 38°C.

*2.3 Zone 1: An area extending 200 m on either side of the centre line of any continuous 1 km length of pipeline that contains five or fewer dwelling units intended for human occupancy.

*2.4 Zone 2: An area extending 200 m on either side of the centre line of any continuous 1 km length of pipeline that contains more than five dwelling units intended for human occupancy or is a facility that contains more than 20 persons during normal use.

2.5 Pipeline Segment: A pipeline or a portion of a pipeline on which a material balance calculation is performed.

* Zone definitions and interpretation with respect to this Recommended Practice are limited solely to defining population density areas in a way which is consistent with industry standards. They are not to be construed as an application or recommendation to apply CSA Z183 Standards to LVP pipelines.

2.6 LVP Gathering Segment: A pipeline segment defined by the following characteristics:

- a) transports only LVP material;
- b) connects tankage, batteries, plants or truck terminals to terminal tankage, another LVP Gathering Segment, or an LVP or HVP Transmission Segment;
- c) has multiple inputs but only a single output;
- d) the flow rate frequently changes because of the cyclical or random production of the different inputs;
- e) the flow rate never exceeds $150 \text{ m}^3/\text{h}$;
- f) segment input points do not exceed 20 in total.

2.7 LVP Transmission Segment: A pipeline segment defined by the following characteristics and not covered by 2.6:

- a) transports only LVP material;
- b) receives material from LVP Gathering Segments, other LVP Transmission Segments, refining areas or terminal tankage and transports it to other LVP Transmission Segments or terminal tankage;
- c) has few inputs and few outputs;
- d) the flow rate is generally steady and predictable;
- e) segment input points do not exceed 20 in total.

2.8 HVP Segment: A pipeline segment which transports at least one HVP material and does not exceed 20 input points in total.

2.9 Low-Volume Segment: A pipeline segment which transports volumes of $15 \text{ m}^3/\text{h}$ or less on a regular basis.

2.10 Intermediate-Volume Segment: A pipeline segment which transports volumes in excess of $15 \text{ m}^3/\text{h}$ but less than $150 \text{ m}^3/\text{h}$ on a regular basis.

2.11 High-Volume Segment: A pipeline segment which transports volumes of $150 \text{ m}^3/\text{h}$ or more on a regular basis.

3. REFERENCE PUBLICATIONS

The following publications are referred to in this Recommended Practice or are useful in developing adequate leak prevention and detection procedures.

CSA Standard Z183 - Oil Pipe Line Transportation Systems
(latest edition)

CGA Recommended Practice OCC-1-1972
Underground or Submerged Metallic Piping Systems

API Manual of Petroleum Measurement

Alberta Pipeline Act, and Regulations

4. PIPELINE CORROSION CONTROL

- 4.1 Operators of pipeline transportation systems covered by this Recommended Practice should carry out corrosion control methods as necessary to counteract internal and external corrosion.
- 4.2 External pipeline corrosion control methods should be applied to all buried pipeline systems and they should be installed, operated, and maintained in accordance with CGA Recommended Practice OCC-1-1972 Underground or Submerged Metallic Piping Systems.
- 4.3 Internal corrosion control measures should be taken as determined by the corrosive effects of the commodity being transported. Control measures should include, but not necessarily be restricted to, such practices as defined in CSA Standard Z183 (latest edition).
- 4.4 Records should be maintained to verify the operation and effectiveness of corrosion control measures.

5. OVER-PRESSURE PROTECTION

- 5.1 Pressure testing of pipeline transportation systems covered by this Recommended Practice should be carried out in accordance with the Pipeline Act and Regulations.
- 5.2 Operating pressures of pipeline transportation systems under steady state operation should not exceed the licensed maximum operating pressure of the system and, in addition, under non-steady state or upset conditions should not exceed the allowable over-pressure tolerances defined in CSA Standard Z183 (latest edition).

- 5.3 Pump stations should be equipped with at least two independent over-pressure limiting devices to prevent exceeding the allowable over-pressure tolerances defined in CSA Z183 (latest edition).

6. PRESSURE LOSS DETECTION

- 6.1 A low discharge pressure shutdown should be provided at each pump station where normal operating conditions permit. In the event of an abnormal time period of low discharge pressure the station should automatically shutdown.

7. EXTERNAL PIPELINE DAMAGE PREVENTION

- 7.1 Operators of pipeline transportation systems covered by this Recommended Practice should establish effective pipeline damage prevention control measures concerning the excavation or movement of soil and operation of equipment within pipeline right-of-way boundaries. (Activities involving normal soil cultivation practices are excluded.) Reference the Pipeline Act and Regulations.
- 7.2 All subsurface crossings of pipeline transportation systems should be performed in accordance with CSA Standard Z183 (latest edition) and in compliance with the requirement of the regulatory authority.
- 7.3 All surface crossings of pipeline transportation systems should be designed and constructed in such manner as to prevent excessive external stress or damage to pipeline transportation systems in place.
- 7.4 Erosion or slumping of soil within pipeline rights-of-way should be investigated and corrective action should be taken as required.
- 7.5 Pipeline warning signs should be installed and maintained in accordance with the Pipeline Act and Regulations.

8. RIGHT-OF-WAY INSPECTION

8.1 General Consideration: Each operator should establish a procedure to carry out regular inspection of the right-of-way occupied by its system.

8.1.1 Such inspection should confirm that all markers and signs identifying the pipeline are in place and legible.

8.1.2 Special consideration should be given to areas of high population density, water crossings, or terrain subject to erosion.

8.1.3 Rights-of-way should be visually inspected at the frequency indicated in Table 8A.

TABLE 8A

FREQUENCY OF VISUAL INSPECTION OF PIPELINE RIGHTS-OF-WAY

Segment	HVP Segments LVP Transmission Segments		LVP Gathering Segments	
	1	2	1	2
Frequency	Two Weeks	One Week	Two Months	One Week

8.1.4 Records of visual inspections should be retained for a minimum period of two years.

8.1.5 Daily inspections should be made in areas of construction activity in the vicinity of the pipeline right-of-way. Continuous inspection should be carried out during periods when construction, which may affect the safety of the pipeline, is taking place on a right-of-way.

8.2 River or Stream Crossing Inspection:

8.2.1 An annual inspection of all river or stream crossings should be made for a period of three years after construction of the crossing or until sufficient

information is compiled to establish that erosion is not taking place. Thereafter, at crossings where no erosion is evident, the inspection need only be performed at three year intervals.

- 8.2.2 The schedule of inspection defined in 8.2.1 should be conducted by ground parties.
- 8.2.3 Additional inspections of river crossings should be carried out following excessive or flood runoff conditions.
- 8.2.4 At river crossings where erosion is evident, engineering survey measurements, including a crossing profile, should be taken annually or as required to determine the rate of erosion.

9. PIPELINE SYSTEM MAINTENANCE AND REPAIR

- 9.1 Pipeline transportation systems covered by this Recommended Practice should be maintained and repaired at such levels as necessary to ensure a high degree of pipeline system integrity.
- 9.2 Pipeline modifications and repairs should be performed in accordance with standards as set forth in CSA Standard Z183 (latest edition).
- 9.3 All pipeline transportation system protective, control, and monitoring devices should be inspected and tested every twelve months to confirm proper operation.
- 9.4 All remotely controlled block valves should be tested by partial operation every three months and any required repairs made as soon as practical.
- 9.5 All manual block valves should be tested by partial operation once per year and any required repairs made as soon as practical.
- 9.6 Adequate records should be kept covering pipeline system maintenance practices and repair work.

10. BLOCK VALVE SPACING

- 10.1 Block valve spacing should conform to CSA Standard Z183 (latest edition).

11. MATERIAL BALANCE

11.1 Definition and General Requirements:

Material Balance for the purpose of this Recommended Practice is any mathematical procedure based on the laws of conservation of matter and fluid mechanics which is used to determine whether a leak has developed in a pipeline system.

Each operator of a pipeline system should establish an operating procedure whereby a material balance is made for all liquid petroleum transported in the pipeline system. To the extent that the system deviates from ideal steady-state flow conditions or from handling a homogeneous line fill, the operator shall consider at least the following conditions in establishing an acceptable material balance for his particular pipeline system:

- a) Changes in pumping configuration, valving, or flow control during the material balance period;
- b) Accuracy of the measurement equipment used to measure each liquid handled;
- c) Physical characteristics of the liquid being measured;
- d) Compressibility of the different liquids transported in the pipeline system;
- e) Temperature variations in the pipeline system;
- f) Differences between the physical characteristics of the liquid being measured at the input and output ends of the pipeline system;
- g) Volume shrinkage due to blending of different liquids in the pipeline system.

To the extent that an individual pipeline system experiences operating conditions other than those noted above, these unique conditions should be recognized and taken into account in establishing an acceptable Material Balance.

Acceptable tolerances for the material balance deviations should be established for each segment based on normal operating conditions.

11.2 Material Balance for LVP Gathering Segments

11.2.1 General Requirements

- a) A maximum of twenty inputs should be allowed on each segment. All inputs should be measured.
- b) The output of each segment should be measured.
- c) All measurement devices should have a measurement repeatability of ± 0.5 percent under installed operating conditions. Where conditions warrant, measurements should be corrected for temperature. All measurements should be rounded to the nearest 0.1 m^3 .
- d) Pipeline equipment should be installed to ensure that only liquid is present at all times in the segment.
- e) Insofar as possible, throughput fluctuations within all segments should be minimized.

11.2.2 Material Balance Procedure

- a) Expected daily, weekly, and monthly volumes should be established for each segment.
- b) The expected volume for the segment should be compared daily, weekly, and monthly, to the volume measured by the output measurement device. Excessive deviations should result in immediate investigation.
- c) At least once per month, actual volumes should be obtained from each input within a segment and a material balance calculation performed. Excessive deviations should result in immediate investigation.

11.2.3 Record Keeping

A record of the daily, weekly, and monthly material balance results should be kept for a minimum period of twelve months.

11.3 Material Balance for LVP Transmission Segments

11.3.1 General Requirements

- a) A maximum of twenty inputs should be allowed on each segment. All inputs should be measured.
- b) The actual measurements from each input do not need to be included in every material balance calculation provided that:
 - i) In no case should the total daily volume from such inputs exceed 5 percent of the total daily volume transported in the segment; and,
 - ii) In no case should any such input represent more than 1 percent of the total daily volume of the segment.
- c) The outputs of each segment should be measured.
- d) All measurement devices should have a measurement repeatability of ± 0.5 percent under installed operating conditions. Where conditions warrant, measurements should be rounded to the nearest 0.1 m^3 .
- e) Pipeline equipment should be installed to ensure that only liquid is present at all times in the segment.

11.3.2 Material Balance Procedure

- a) An expected volume should be established for each input which does not have an actual measurement.
- b) The expected volume for such inputs should be included in all material balance calculations.
- c) At least once per month, actual volumes should be obtained from all inputs and outputs and a material balance calculation performed. Excessive deviations should result in immediate investigation.
- d) Notwithstanding the above provisions for inputs without actual measurement, material balance calculations should be performed at the frequencies specified in Table 11A. Excessive deviations should result in immediate investigation.

TABLE 11A

MATERIAL BALANCE REQUIRMENTS FOR LVP TRANSMISSION SEGMENTS

VOLUME	HIGH		INTERMEDIATE		LOW	
ZONE	1	2	1	2	1	2
FREQUENCY OF DATA RETRIEVAL	1 h	5 min	24 h	1 h	1 wk	24 h
FREQUENCY OF MATERIAL BALANCE CALCULATIONS (ALL REQUIRED)	1 h 24 h 1 wk	5 min 24 h 1 wk	24 h 1 wk 1 mo	1 h 24 h 1 wk	1 wk 1 mo	24 h 1 wk 1 mo

Notes:

1. Material Balance Calculations are required by Table 11A at all frequencies indicated on each line segment in order to identify leaks of various magnitudes. It is expected that the acceptable deviations will be tighter for calculations performed over greater periods of time.
2. Wherever a five minute calculation is specified, the requirement is that a calculation be performed every five minutes using volume or mass data gathered over a sufficiently long period of time to produce a meaningful calculation. For example, the balance could be performed every five minutes using data accumulated for the preceding hour.

11.3.3 Record Keeping: A record of the hourly, daily, weekly, and monthly material balance results should be kept for a minimum period of 12 months.

11.4 Material Balance of HVP Segments

11.4.1 General Requirements

- a) A maximum of twenty inputs should be allowed on each segment. All inputs should be measured.

- b) The output of each segment should be measured.
- c) All measurement devices should have a measurement repeatability of $\pm 0.5\%$ under installed operating conditions. Where conditions warrant, measurements should be corrected for temperature. All measurements should be rounded to the nearest 0.1 m^3 .
- d) Pipeline equipment should be installed to ensure that only liquid is present at all times in the segment.

11.4.2 Material Balance Procedure: Material balance calculations should be performed at the frequencies specified in Table 11B. Excessive deviations should result in immediate investigation.

TABLE 11B
MATERIAL BALANCE REQUIREMENTS FOR HVP SEGMENTS

VOLUME	HIGH		INTERMEDIATE		LOW	
ZONE	1	2	1	2	1	2
FREQUENCY OF DATA RETRIEVAL	1 h	5 min	24 h	5 min	1 wk	5 min
FREQUENCY OF MATERIAL BALANCE CALCULATIONS (ALL REQUIRED)	1 h	5 min	24 h	5 min	1 wk	5 min
	24 h	24 h	1 wk	24 h	1 mo	1 wk
	1 wk	1 wk	1 mo	1 wk		1 mo

Notes:

1. Material Balance Calculations are required by Table 11B at all frequencies indicated on each line segment in order to identify leaks of various magnitudes. It is expected that the acceptable deviations will be tighter for calculations performed over greater periods of time.
2. Wherever a five minute calculation is specified, the requirement is that a calculation be performed every five minutes using volume or mass data gathered over a sufficiently long period of time to produce a meaningful calculation. For example, the balance could be performed every five minutes using data accumulated for the preceding hour.

11.4.3 Record Keeping: A record of the hourly, daily, weekly, and monthly material balance results should be kept for a minimum period of 12 months.

11.5 Excessive Deviations: Excessive deviations should be cause for immediate investigation, providing that previously known circumstances do not exist which, in the judgement of the operator, clearly explain the deviation.

11.6 Trend Recording: A pipeline may develop a leak which is not sufficient to exceed the deviation tolerance set for material balance and consequently it may go undetected for some period of time. The records left from previous calculations may clearly show that a trend has been established and it is an operator responsibility to review the records at appropriate intervals.

11.6.1 Manual Calculation: In systems where a manual material balance is performed, the operator must examine the results of previous calculations to determine whether a trend is evident.

11.6.2 Automated Calculation: In automated systems trends may be detected by using any of the following methods:

- a) By running accumulative totals of the material balance calculations over different periods of time. For example, totals for four hour, daily, and weekly periods could be maintained and deviation alarms could be established for these periods.
- b) By displaying the results of previous calculations in tabular or graphic form for operator interpretation.

12. EMPLOYEE TRAINING

12.1 Operators of liquid petroleum pipelines should ensure that each employee has received training and education appropriate to each employee's job duties and responsibilities.

12.1.1 Employees responsible for the control of liquid movement in the pipeline should be knowledgeable and receive ongoing training specifically in the following areas:

- a) The physical characteristics of all liquids carried by the pipeline system and the hazards created by their release.

- b) Liquid pipeline hydraulics as applied to their particular system and related operational procedures.
 - c) The material balance method used on each line segment and the interpretation of any imbalances.
 - d) The contents and interpretation of the operator's Material Balance Manual and Emergency Contingency Manual.
- 12.2 Each operator of a liquid petroleum pipeline should have a Material Balance Manual, or equivalent, readily available for reference by those employees responsible for material balance on the pipeline. The intent of the manual is to collect all documents which may be relevant in a potential leak situation under a single cover. It is recommended that the following material be included in the manual:
- a) A map and profile for each pipeline segment;
 - b) A tabulation of normal and extreme linepack variations for each pipeline segment;
 - c) A tabulation of normal, cautionary, and extreme material balance tolerances for each pipeline segment;
 - d) A tabulation of the meters, tanks, and minimum and maximum pumping rates for each station on each pipeline segment;
 - e) A list of special considerations or step by step procedures to be used in evaluating excessive material balance deviations;
 - f) A summary of the characteristics of each product and specific actions or information to be given to police, municipal or government authorities in the event of a spill;
 - g) A list of the parties to be contacted in the event of a spill.

13. EMERGENCY CONTINGENCY ACTION PLAN

- 13.1 Operators of pipeline transportation systems covered by this Recommended Practice should establish and have in place for immediate implementation an emergency contingency action plan detailing emergency procedures concerning product escape or spillage.

13.2 The plan should include, but not be restricted to, the following:

- a) Procedures for shutdown and control of the pipeline system;
- b) Procedures of isolating source of product escape or spillage;
- c) Procedures of product escape or spillage containment and clean up;
- d) Procedures of notification to affected parties (e.g., municipal agencies, regulatory bodies, industry, public).

12.3 The plan of the project is to be completed by the end of 1961.

- a) The project is to be completed by the end of 1961.
- b) The project is to be completed by the end of 1961.
- c) The project is to be completed by the end of 1961.
- d) The project is to be completed by the end of 1961.